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TITLE:	**fex21 Charging Features/Troubleshooting**
ABSTRACT:	Details for the fex21 charging and battery system

Introduction
This document is intended to provide a detailed description of the fex21 charging system and battery parameters.

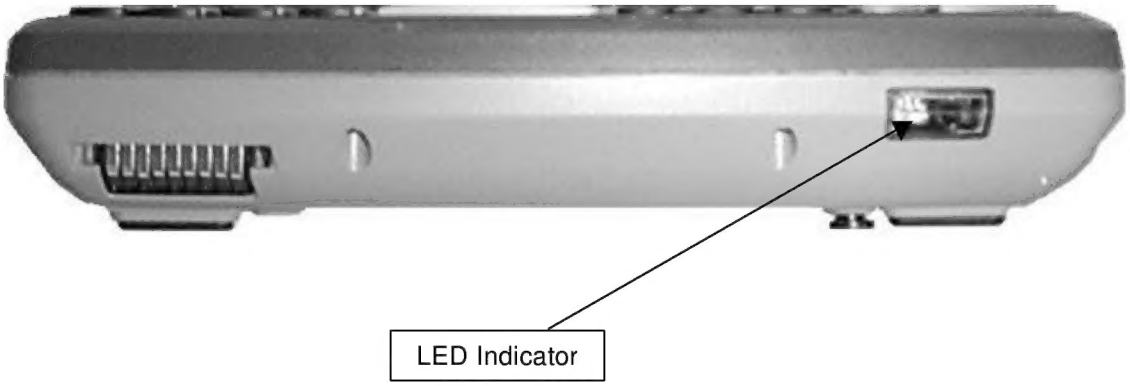
Battery Description
The fex21 is designed for use with either a rechargeable NiMH battery pack or 4 AA-size alkaline cells. Both types are contained within a specially designed battery holder. The fex21 is supplied as standard with a rechargeable battery. The alkaline battery holder may be purchased as an optional extra from Itronix (UK).

Use of non-rechargeable alkaline batteries is only recommended as an emergency measure. The quality of alkaline cells cannot be guaranteed, as Itronix does not supply them.

In addition to the main NiMH battery the fex21 has a built in rechargeable backup battery. This internal cell is used to retain the contents of the unit RAM in the event of complete power loss from the main cell. This backup battery will retain the RAM contents of the unit for up to 72 hours (depending upon charge state). This backup cell also allows the user to safely swap the main cell without compromising the machine data integrity.

LED Indicator
The fex21 incorporates a battery-charging indicator situated behind the IrDA window. This red LED indicates the state of charging in the following ways:

- LED off: AC Adapter not connected or AC adapter not switched on
- LED On: The unit is running on AC adapter power. This state also indicates that charging is complete, disabled or not allowed (battery too hot/cold, or no rechargeable battery fitted).
- Slow regular flashing (once per second): The unit is running on AC power and the battery is charging.
- Fast irregular flashing: The unit is running on AC adapter power. Battery charging has not started or has been aborted. This may be indicative of a battery fault or that a battery has over-heated. Please refer to the battery section in the trouble-shooting guide for further details.



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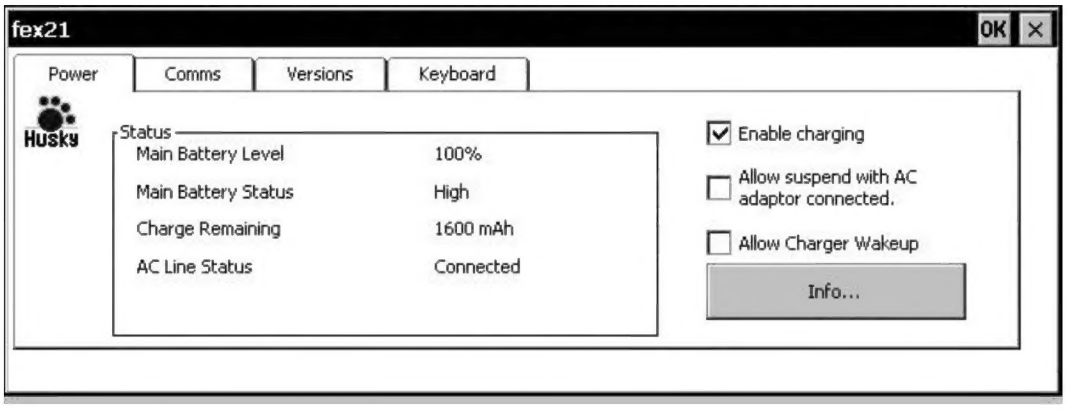
fex21 Util Applet

The fex21 Util applet (accessible from the control panel) is a vital source of battery and power information for the device. The following passages describe the information contained within this applet in detail.



Main Battery Level

The *Main Battery Level* displays the current percentage remaining in the main power cell. This is an accurately estimated value based on the time active since last full charge and takes into account any self discharge of the cell whilst the device is powered off. The value also accounts for the battery power consumed maintaining the RAM contents of the unit. If the system thinks for any reason this value may be inaccurate then there will be a question mark (?) displayed adjacent to the value. If this happens then the unit will need to be placed on charge until the value reaches 100%, at this point the gas gauge will be reset and the value will once more be accurate.

Please note that if the unit has recently been charged to 100% charging will not restart until the gas gauge value has gone below 96% or for 24 hours after last charge. This feature was introduced into micro version 990D0 and above to prevent damaging charge regimes.

Main Battery Status

The main battery status can display four possible states:

High
Low
Critical
Charging
No Battery

The High, Low and critical values are taken as a voltage reading from the battery and further reinforce the main battery level percentage. It is also from these values that the battery warnings are taken.

When the battery is charging an accurate voltage reading cannot be taken from the battery as it is constantly changing so the flag *Charging* is used in it's place.

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Charge Remaining
The charge remaining denotes the value in mAh left in the main cell. This value is calculated in the same way as the charge percentage remaining.

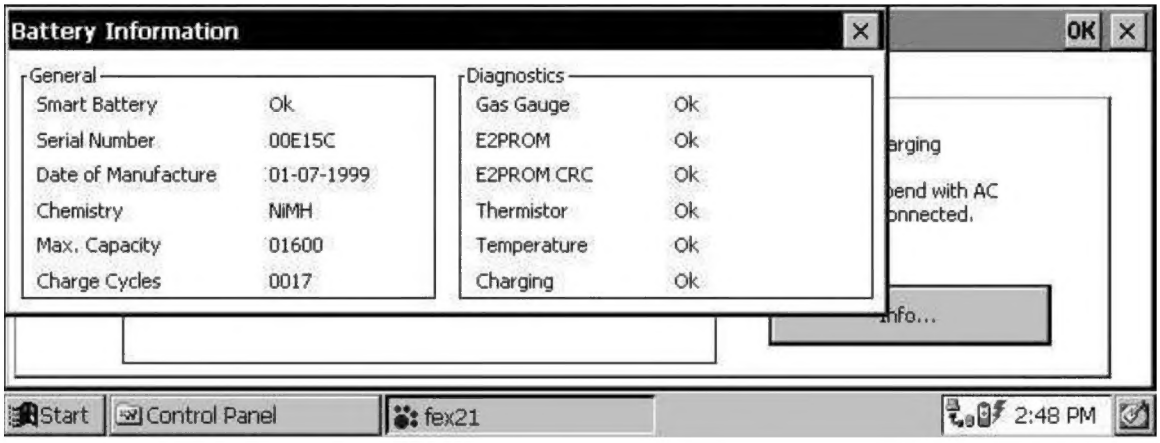
AC Line Status
The AC line status denotes whether or not the external charger is connected to the fex21. This status will read either *connected* or *not connected.*

Enable Charging
Charging can be enabled or disabled by use of this checkbox. When checked the unit will begin to charge automatically whenever the AC line is connected to the device. When not checked the unit will not charge regardless of what the AC line status is.

Allow suspend with AC adapter connected
If this box is checked then the unit can be powered off by use of the power key whilst the AC adapter is connected. This is not allowed by default, as the fex21 ***must*** be powered on in order to charge. Immediately the unit is powered off the device will cease charging. The device will not suspend automatically whilst on external power even with this option selected.

Allow Charger Wakeup
This option will allow the fex21 to resume from a suspend state immediately on charger insertion. *This option was only included on later revision units and may not be available on all systems.*

Battery Info Button
The fex21 contains a 1600mAh smart battery as it's main power cell. This smart battery is capable of providing a lot of information to the user. By pressing the Info button within the fex21 Util Applet power tab this detailed battery data can be viewed. Please note if the fex21 is being used with alkaline cells then this information will not be available to the user.



Smart Battery
This line will tell the user whether the smart battery status is OK or FAILED. If it reads FAILED then the reason for failure can be displayed in the Diagnostics box opposite. If the unit is working on external power or contains alkaline cells this option will display 'None Fitted' and the remaining information will be greyed out.

Serial Number
This value displays the serial number of the battery not the serial number of the unit into which it is inserted.

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Date of Manufacture
This value displays the date the battery was manufactured, (Date format is British dd-mm-yyyy). This can be useful in determining when the battery is due for replacement, as can the charge cycles. It is recommended that the battery be replaced every 18 months or 500 charge cycles, whichever is sooner.

Chemistry
This displays the battery chemistry in use. Currently this is limited to NiMH only however other battery types may become available in the future.

Max Capacity
This displays the design capacity in mAh of the battery being used.

Charge Cycles
This value represents the number of times the battery has been charged and discharged.

Gas Gauge
This value denotes whether the gas gauge is deemed by the system to be OK or failed. If this reads Failed then the battery may be faulty.

E2PROM & E2PROM CRC
These two values denote whether the E2PROM (Smart battery information store) is working correctly. If either of these values read anything other than OK then some or all data from the smart battery may be incorrect. The incorrect data will be greyed out. If this happens then the battery will have to be replaced.

Thermistor
The fex21 contains a NiMH cell, which it is dangerous to charge at extreme temperatures. The in battery thermistor is the temperature control for charging. If the thermistor is set High or Low then this indicates that the thermistor itself is faulty. In this instance charging will be aborted and will not re-commence. This failure also means the battery will have to be replaced.

Temperature
This value denotes whether the battery temperature is too low, too high or OK. The battery will not charge if the temperature value is set to anything other than OK due to the danger presented by charging NiMH batteries at temperature extremes.
The battery will not start charging above 40ºC or below 0ºC

Charging
This line will denote whether charging is OK, failed or aborted. If this is set to any value than OK then the other information stored within the info screen will usually point to a reason for failure. There will also be an error code displayed if charging has failed. The codes are interpreted as follows:

0	=	Incorrect chemistry (Battery not a NiMH cell therefore the system will not attempt charging)
1	=	Battery Over Temperature (Battery is too hot to safely charge)
2	=	Battery over volts (Battery voltage is too high. This indicates a battery failure)
3	=	Time out (Battery has not completed charging within the maximum time limit of 2.5 hours, this code is also an indication of a battery problem)

If charging is aborted for any of the above reasons then the aborted flag will remain in place. The charging flag will not be reset until the charger is removed and the unit powered off then back on.

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Battery Troubleshooting

Gas Gauge

One subject that has arisen many times in connection with the fex21 is charge life. The fex21 gas gauge does not become accurate until the battery has been charged to 100%. Many users charge the battery to 99% and believe that this will be sufficient for a working day. It is actually the case that a 99% charge is usually more indicative of a charging failure. This value has previously been used in the Micro Controller as a default display value. This practice has now been changed in newer Micro versions.

In order to ensure the gas gauge is accurate the user must charge the unit to 100% prior to use. At this level the gas gauge resets all it's values and begins to display accurate information.

In later versions of the Micro Controller the gas gauge value will have an adjacent question mark if the system believes it to be inaccurate. One example of this is when a battery from another unit is placed in the fex21. The unit will not know the gas gauge value and therefore a question mark will be placed adjacent to the reading.

Please note that as this information is controlled by the Micro Controller this is not O/S version specific.

Battery Temperature

The fex21 contains a 1600mAh NiMH main cell for its primary power supply. Due to the battery chemistry charge temperature is of great importance. The fex21 battery system will abort charging at 52ºC. When this happens, the battery indicator LED will flash irregularly.

When the battery is charged for the first time it will almost certainly reach this critical temperature before it reaches full charge. This means that charging is aborted before completion and the gas gauge is not reset. If this does happen then remove the charger and power the unit down for about an hour to allow the battery to cool. Re-insert the charger and power the unit back up to continue charging. In this instance charging may complete within a few minutes.

Back-up Battery

The lack of back-up battery information has caused some confusion with many customers. Unlike many other CE devices the fex21 is equipped with a rechargeable backup cell. This cell is constantly trickle charged from the main battery. An unfortunate side effect of this recharge procedure is that a value cannot be obtained for remaining battery life. It is for this reason that the backup battery power remaining screen within the operating system is greyed out. This is normal for the fex21 and does not indicate battery failure.

Battery Storage

In order to maintain the fex21 battery efficiency during extended periods of storage a few guidelines should be followed.

The optimum temperature for battery storage is between -20ºC to 35ºC. As a general rule the higher the temperature the higher the discharge rate of the cells.

During extended storage the NiMH cells will require recharge at regular intervals. When the batteries are being stored in the fex21 they will require a recharge cycle every 30 days. When stored externally to the fex21 at 20ºC or lower then the batteries will require recharging every 90 days. At higher temperatures this should be reduced to every 30 days.

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